Weather Note

RADAR OBSERVATIONS OF THE EL DORADO, KANS. TORNADO, JUNE 10, 1958

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1. INTRODUCTION

This note on the tornado that struck El Dorado, Kans., on June 10, 1958, deals primarily with the radar scope presentations of the cloud echo and is based on the personal observations of the author who was operating the WSR-3 radar at Weather Bureau Airport Station, Wichita, Kans. A sequence of radar photographs and a description of radar features observed but not photographed are presented. A well-formed hook of short duration in the right rear quadrant of the echo is one of the main features evident in the photographic sequence.

The presentation of the radar observations is preceded by a brief summary of the synoptic conditions with which the storm was associated.

2. SYNOPTIC FEATURES

The correct interpretation of radar scope presentations and their use in issuing weather forecasts and warnings require the radar observer to be thoroughly familiar with the concurrent synoptic weather picture. The salient synoptic features of the June 10, 1958, storm situation are summarized in figure 1. At the surface was a low pressure trough with a slowly moving cold front across eastern Kansas. Ample moisture for convective activity was available at low levels over eastern Kansas as evidenced by dew point temperatures of 12° C. and higher at 850 mb.

At the 700-mb. level overriding cooler air in a bubble High that developed over northwestern Kansas and moved southeastward contributed to the instability of the air. Instability indices were exceptionally large. Another important feature was the strengthening of the jet level winds over Oklahoma and Kansas.

All of these synoptic clues to a developing severe weather situation served to alert the author to the necessity for maintaining a vigilant watch on the radar scopes.

3. RADAR OBSERVATIONS

The echo that was associated with the tornado first attracted attention at WBAS, Wichita, at 1540 CST because of its rapid intensification. At that time, the cloud was centered 37 n. mi. to the north-northwest of Wichita and was visible from the Weather Bureau office as a towering cumulus cloud with vigorous development of its "cauliflower top."

During the next hour (1540–1640 CST) the cloud moved in a general easterly direction with a speed of about 17 knots. About 1643 CST a notch or indentation appeared on the far side of the echo (in relation to the radar station) and the storm changed to a southeastward direction of movement; the trailing portion of the echo nearest the station moved at a speed slightly exceeding 20 knots.

Figure 2 displays a sequence of photographs of the Plan Position Indicator (PPI) scope. The 1650 CST photograph shows the fading notch on the northeast side of the echo and the beginning of a hook appendage in the right rear quadrant of the echo.

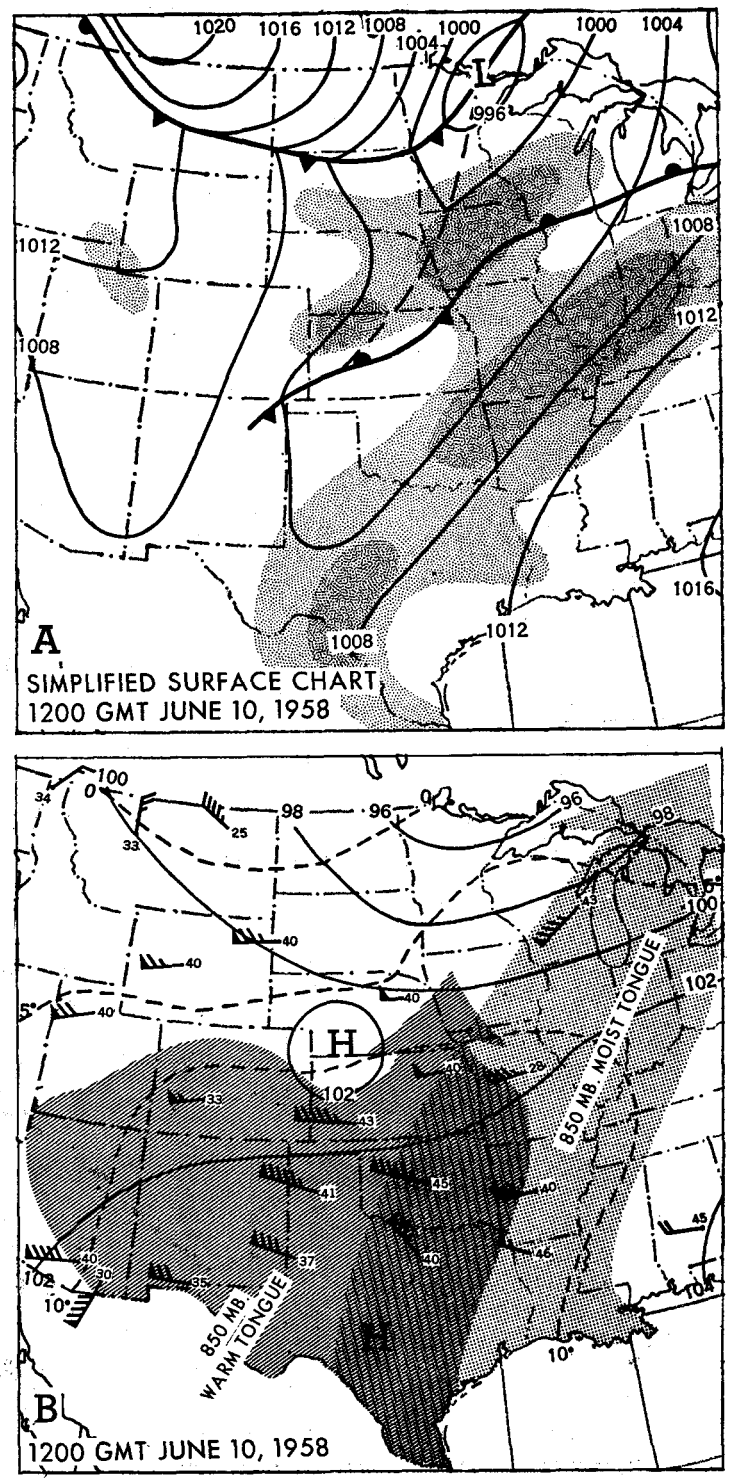

Figure 1.—Synoptic situation at 1200 GMT, June 10, 1958. (A) Surface isobars and fronts with area of negative stability index shaded. Darker shading indicates values of −4 and lower. (B) 700-mb. contours and isotherms with 850-mb. warm and moist advection indicated by shading. Winds are for jet level with height given in thousands of feet.

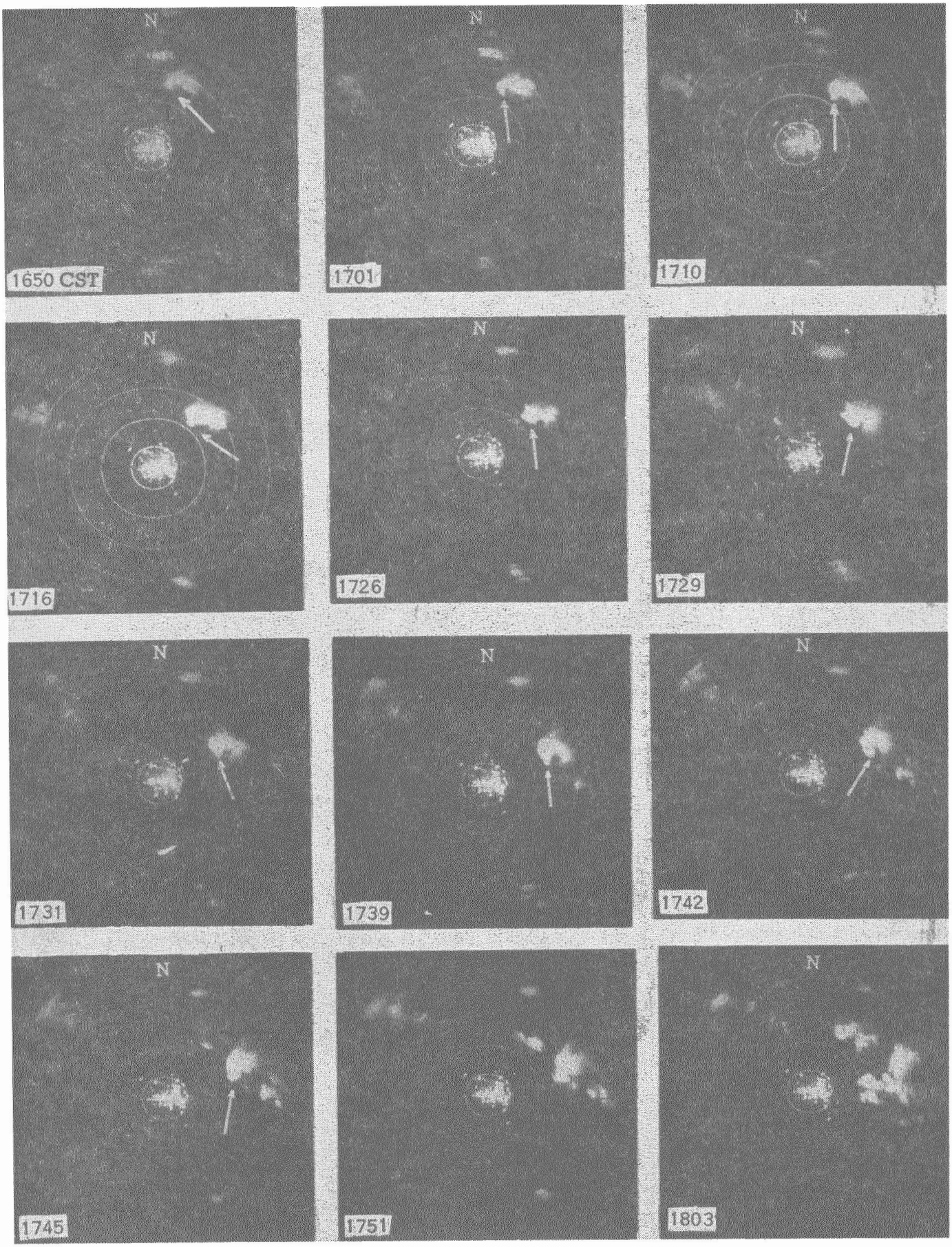

Figure 2.—Radar PPI scope photographs taken at WBAS Wichita, Kans., on June 10, 1958 during time of tornado at El Dorado, Kans. Range is 50 n. mi. (10 n. mi. between rings) and antenna elevation 0°.

The 1701 CST photograph shows the most pronounced appearance of the hook on the echo. Because illumination from the last sweep of the antenna (rotating at 4 revolutions per minute) was still faintly visible during observation as each new sweep moved across the echo, it was possible to see the growth of the echo in a cyclonic sense to form the hook. Such an observation of echo growth between sweeps would be discernible only in cases of very rapid echo development. A rough computation of the advance of the echo's formation by the observable movement and development gave a speed of about 300 knots. This observation is another that can be added to the already many films indicating the circulation of the hook actually to be cyclonic in nature and not a divergent outflow.

The duration of an easily identifiable hook was the short time of about 15 minutes. While the hook was evident the State police were asked to investigate the storm associated with the echo. Their report was that no tornado or funnel was observed, although it was raining with some hail in the area of the hooked echo. At 1720 CST a report was received that White Water (see fig. 3) had hail up to 3 inches in diameter but little rain and wind. The hailstorm was coincident with the radar echo.

The 1726 CST picture shows no evidence of a hook; only a slight protrusion still existed. At 1729 CST the sharp-edged protrusion was still plainly visible. At this time eyewitnesses at the El Dorado Interchange on the Kansas Turnpike spotted a funnel-shaped cloud about 3,000 feet up and about 7 miles to their west (see fig. 3). This position was coincident with the radar echo.

The 1735 CST photograph shows that the protrusion was still plainly visible and by 1739 CST it became even more plainly defined by its sharp-edged hard appearance. The protrusion gradually merged with the main cell and by 1751 CST was no longer identifiable. Shortly thereafter, at about 1755 CST, the tornado "pumped" down from the parent cloud on the outskirts of El Dorado at the approximate location given in figure 3. The information about the tornado "pumping" action was given by a survivor of the devastated area of El Dorado who had a good view to the west across an open field. He saw the tornado "pump" down to the ground while the cloud was over the Midian Substation on the western outskirts of El Dorado. Each successive "pumping" action lowered the funnel until it contacted the ground. There was a light sprinkle of rain falling from the cloud between the survivor and the funnel.

When he saw the funnel touch the ground, the survivor and his family went to the basement of their home, which about 2 minutes later was destroyed by the tornado. All were safe, as indeed were all the residents of this street; they, too, had gone into their basements and survived the destruction of their homes.

Another eyewitness account of the tornado's approach to El Dorado was given by a State Highway Patrolman, Mr. Robert Lemon, who made positive identification of the tornado approaching the southwestern section of El Dorado. Following is Mr. Lemon's statement:

"I was observing a Wichita television program at my home shortly before coming on duty at 1700 CST. The television program was interrupted to give a severe weather bulletin. [SELS Severe Thunderstorm forecast No. 127 issued at 1630 CST included this area as subject to severe thunderstorms with isolated hail and damaging wind storms.] The sky looked very ugly with thunder and lightning in the distance, heavy clouds, rather still surface conditions, and very hot. The Weather Bureau has furnished informational material on tornadoes, and State Headquarters has insisted that all patrolmen study this subject. I was driving north about ½ mile north of the Skelly Oil Refinery on the Kechi-Towanda road, when to my amazement, I saw a straight-sided column of whirling mass extending from the base of the cloud to the ground. This column was white in color and was moving from the northwest to the southeast at quite a rapid rate. I immediately radioed the Chief of Police, the El Dorado Sheriff, and the Highway Patrol District Headquarters in north Wichita. Flying debris in advance of the tornado began closing my path. I had to stop and back up and take another route into El Dorado. I radioed my observation at 1755 CST. [This time confirmed by north Wichita Headquarters communication log.] The tornado funnel traveled almost in a U shape, approaching from the northwest, turned to straight west, and was changing to a southwesterly direction when it lifted back up into the clouds."

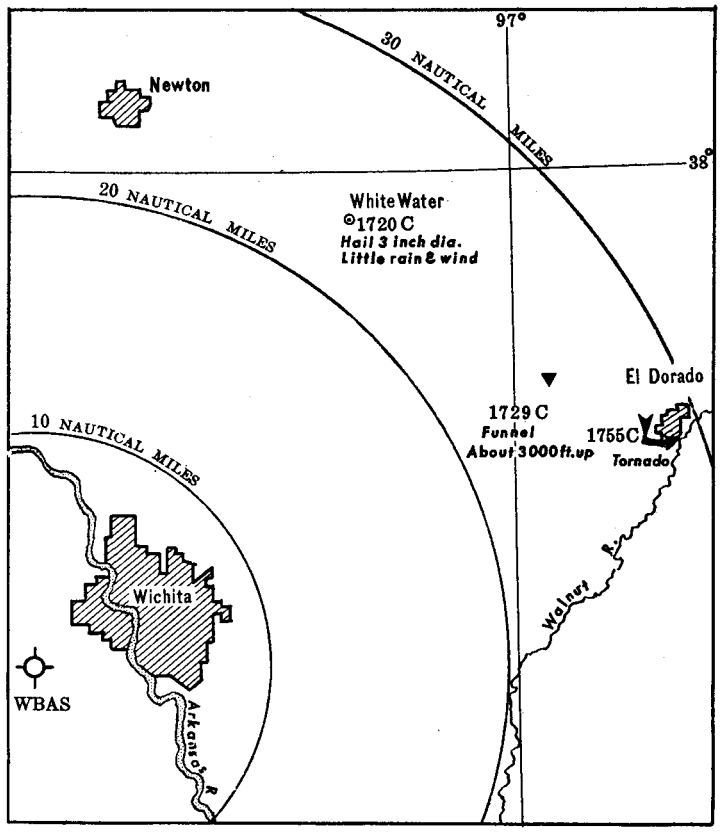

Figure 3.—Map of Wichita-El Dorado area.

The tornado made a U-shaped path, with the bottom portion of the U being the west-to-east path through southwestern El Dorado as shown in figure 3. In the right portion of the U the funnel was described as withdrawing into the cloud.

The tornado destroyed or damaged some 150 homes, injured 50 persons, and killed 15. Property damage was estimated at $3 million.

4. CONCLUSIONS

The true hook of the cloud associated with the El Dorado tornado was viewed by radar as a cyclonic swirling of the cloud echo into a hook-shaped appendage. The duration of the identifiable hook was only about 15 minutes. This leads to the conclusion that to catch the formation of significant "hooks" on radar echoes the radar operator must observe the scopes continuously during a severe storm situation; otherwise he may miss the hook completely or, if he observes it, be unable to tell whether the appendage is a true hook. If further experience with radar echoes shows that, as in this case, hooks appear well in advance of tornadoes, it may be possible in favorable circumstances to issue advance warnings on the basis of the PPI scope presentations before the tornado drops from the clouds. However, in other cases, additional means, such as visual sightings, Doppler radar, or sferics, are necessary to supplement radar PPI scope observations for the quick identification of tornado-producing formations.